Spring 2019

Guided Alligator Tours Or Raccoon Schooling (GATORS)

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GUIDED ALLIGATOR TOURS OR RACCOON SCHOOLING (GATORS)

By

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Submitted in Partial Fulfillment

of the Requirements for

Graduation with Honors from the

South Carolina Honors College

May, 2019

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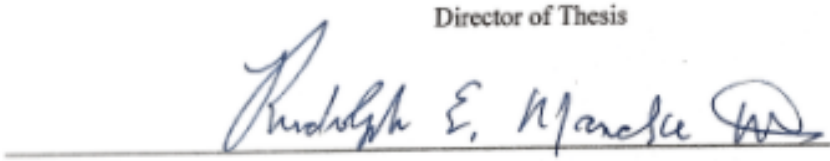

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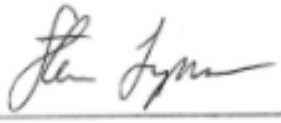

Steve Lynn, Dean

For South Carolina Honors College

Dedication:

This thesis is dedicated to all the animals who have been a part of my work these past four years.

In a special way, it is dedicated to The Four: Ophelia, Ozzy, Odin, and Onyx (RIP).

Acknowledgements:

This project would not have been possible without contributions from many individuals, and I would like to use this section to acknowledge those people

My parents and brother: without their support (financial or otherwise), I would not have been able to have successful experiences at Second Nature and Fripp Island, and thus would not have been able to even begin this project.

Professors John Grego and Rudy Mancke: Professor Grego served as my thesis director, helping to turn my project idea into a reality and enabling connections with Congaree. Professor Mancke served as a second reader, sharing his insight to help make my project a success.

The Staff of Congaree National Park: They enabled me to conduct programs as an official Park volunteer, supporting my work through advertising and logistical arrangements.

Pam Sundeen, and the volunteers, of Second Nature Wildlife Rehabilitation: The raccoon component of this project is a direct result of my time at Second Nature, an experience which would not have been possible without the direction of Pam Sundeen, and which was greatly aided by our volunteers.

Jessica Miller, and the naturalists, of Fripp Island: Working with Jessica Miller and my fellow naturalists provided me the opportunity to learn to lead educational environmental programs and to work with alligators. My work at Fripp Island was the inspiration for this project idea.

Ian Klauck and Tyler Mitchell: They joined me on initial trips to Congaree to begin planning my tours, and they each attended multiple tours in the fall to help provide feedback and support. Ian worked with me on the project for Dr. Grego's course, and he was responsible for the majority of my photos from the fall tours. Tyler provided the iPad I began using for tours.

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Abstract:

In my two main internships during college, I worked closely with two very different animals: raccoons and alligators. Additionally, I gained experience in presenting educational programs during my internship at Fripp Island, where my most common program was our Gator Walk. For my thesis project, I built upon my experience in interpretive programming, drawing on my experience with alligators and raccoons to develop a unique educational program to present at Congaree National Park. This report will describe the process of developing this program as well as it's implementation and outcomes. In addition, it includes a review of scholarly literature on these two animals which was used to inform the tours.

Project GATORS

Background:

In the summer of 2017, I interned at Second Nature Wildlife Rehabilitation in Thompsonville, Illinois. I lived on-site with the director, who (along with myself for the summer) was the only permanent staff. We accepted a variety of orphaned, injured, or ill mammals for care, and a significant portion of our patients were raccoons. Throughout the summer, I came to greatly appreciate the raccoons' inquisitive natures and dynamic personalities, and through first-hand experience I learned much about their behaviors and characteristics.

In the summer of 2018, I worked as a naturalist intern at Fripp Island Resort Activity Center. Through this position, I gained experience in leading educational nature programs, from kayak tours to crabbing. The program I led most frequently was Gator Walk, which introduced guests to the Activity Center's resident educational alligators and took them across the island to look for some of the many alligators which called Fripp home. I continued to work with raccoons

during this summer as well, responding to raccoon-related issues across the island and preparing a special educational program about raccoons to present at the end of the summer.

In the fall of 2018, I took a course with Professor John Grego: Public Engagement, Natural History, and Cultural History in Congaree National Park. For this course, Dr. Grego wanted us to develop a final project associated with Congaree in some manner. After my summer on Fripp Island, I was interested in continuing my work with alligators, and I began planning a way to combine this interest with the project required for Dr. Grego's course. My initial ideas involved creating an educational brochure about alligators at Congaree, but I realized that I could readily take the project to a bigger scale and, using my prior experience, develop an effective senior thesis project. After discussing my ideas with Dr. Grego, I began planning ways to adapt my experience leading Gator Walk at Fripp Island into a program I could lead at Congaree National Park. It was at this time I developed the initial name for my project: Guided Alligator Tours On the River (GATOR).

As I continued planning the project, I decided that my culminating senior project would not feel complete if I did not include raccoons as well. In addition to providing me an opportunity to talk about my favorite animal, including raccoons in the program helped ensure I would have sufficient material to cover for the duration of the tour. I also felt that including a second animal would help ensure people did not have high expectations of seeing an alligator on the tour. After confirming that this addition was acceptable, I modified the initial name of my project to account for raccoons: Guided Alligator Tours Or Raccoon Schooling (GATORS).

Developing the Program:

After discussing my project with Dr. Grego and receiving his approval (as well as recommendations for the program), I met with Scott Teodorski, the director of educational

programs at Congaree National Park. He proved to be quite willing to allow me to hold my program with Congaree and offered some suggestions for possible locations where alligators could be found. Between Dr. Grego and Mr. Teodorski, two primary locations seemed potentially viable: Weston Lake and the 601 Slough.

First, I went to visit the 601 Slough area with my roommate, Tyler. During the visit, I could see how the habitat was well suited for alligators. However, this part of the park has not been well developed, and we realized that it would not be conducive to providing a good experience for guests. In regards to guest experience, Weston Lake (which is located along the park's main boardwalk trail) seemed more promising. I scouted the boardwalk with Tyler as well as my friend Ian (a classmate in Dr. Grego's course who assisted with elements of the project). During this trip, we were able to see the resident alligator in Weston Lake, leading me to decide that the boardwalk loop would be a good location for my program. While the boardwalk only offered one location to potentially see an alligator, I felt the benefits of a well maintained location and proximity to the visitor center outweighed this potential downside. Including raccoons in the program further minimized this potential drawback.

Fall Tours and Modifications:

I held my first tour on Saturday, October 27, and I was pleased to have it attended by a moderate but engaged group of visitors. Unfortunately, some attendees dropped off early on, but a core group remained throughout the entire tour. This group consisted of a couple of my friends, one of my professors and her children (who I invited), as well as a visiting family who had simply read about the program. For this tour, I attempted to walk while talking, making continuous progress down the boardwalk. I also had a series of pictures from Second Nature and

Fripp Island to share at the end of the tour. While the tour went well for my first time, I found there were improvements I could make for the next tour.

I held my second tour a couple weeks after the first one, which gave me time to reflect on the first tour and make necessary modifications. While I felt the pictures provided a helpful visual element to the program, I decided they would be more effective if I could display them during the tour itself. I developed a slideshow (consisting of personal photos as well as some other useful visual aids) which I could display on a tablet and refer to throughout the tour. To allow guests to engage with my tour's content and the visuals, I decided to make stops along the boardwalk to discuss important parts of my program (instead of walking continuously while talking). My second tour had similar attendance to my first, and I believe these modifications were effective improvements. The potential downside to stopping to talk (instead of talking continuously) was that it created some periods of potentially awkward silence as we were walking. However, I do not believe these periods were perceived as awkward by the visitors themselves, at least not to the degree I was concerned they might. As the tour progressed, we warmed up to each other, and by the latter half of the tour there was easy conversation in between stops (the group dynamic in the first program was similar to this).

After the second tour, I was considering attempting to make fewer stops and have more continuous walking while talking (making stops when I wanted to refer to something on the iPad). However, attendance for my third tour far exceeded my expectations, and it was readily apparent that, in order to address the entire group, I would have to stop and talk. This large group readily carried on conversation in between stops, and these in-between periods did not feel potentially awkward. When walking, I made an effort to walk by different families within the group, and I believe this helped enable me to engage everyone within the group more effectively.

Each of these tours had at least one family with children, and engaging these kids proved to be a vital (and successful) element of my tours. I purchased small alligator and raccoon figurines, hoping to add an extra dimension to my program, and allowing the kids to hold them during the talks sometimes seemed to help engage them a bit more. Once I began using the iPad, being able to show photos helped get kids' interest (2 pictures were included specifically to engage the kids: one where I could see if they could spot a well camouflaged alligator, and one where I could challenge them to find all the raccoons). Stopping at Weston Lake to look for animals gave me an opportunity to relate with the kids even more, and they tended to be notably more enthusiastic after Weston Lake. At the beginning of the tours, I made a point to say that any and all questions/comments would be welcome during the program, and the kids never failed to supply interesting questions and stories on a variety of topics. I believe the energy they provided helped make the tours more enjoyable for everyone involved.

Unfortunately, we were never able to see the alligator in Weston Lake on any of these tours. However, this did not seem to bother people at all. Before beginning the walk I would always emphasize that I could not guarantee an alligator sighting, and people always understood. While we never saw alligators, we often saw a number of other animals, from turtles in Weston Lake to Golden Orb Weavers and snakes along the trail. When someone spotted an interesting animal, we would pause to observe it, and generally I was able to provide some interesting facts. These unplanned elements helped engage people as well, even if they did tend to put us over the scheduled two hour duration for the program.

Spring Tours:

At the start of the spring semester, the government shutdown meant Congaree was not operational. Even after it re-opened, I knew they would be dealing with backlog, so I did not

initially reach out to schedule additional tours. By March, park operations were back to normal, and I was able to schedule three more tours for Saturdays in April.

My first spring tour, on April 6, was well attended, larger than the first two fall tours but not as large as the third tour. With the exception of my dad (who came down for the tour), no one else attending was there by my invitation, meaning they had all heard about the program through the park and decided it was interesting (each of my tours in the fall only had one family attending that I had not directly invited). Like in the fall, we did not see the alligator in Weston Lake, but we saw a great number of snakes, as well as turtles and insects. The group (which consisted of children, parents, and young adults around my age) were all readily engaged and interested, with good questions to ask and stories to share. Personally, I felt somewhat rusty leading the program, but the group's energy made up for that potential weakness.

My second spring tour coincided with the Park's celebration of Earth Day, and unfortunately, it was outcompeted by other events happening concurrently. That being said, I should not say that no one attended the tour, because my mom did come down to attend. I was not particularly surprised by this outcome, as the park's bird-focused Earth Day events were the primary focus that day. The weather was also more overcast, which may have reduced potential attendance.

My sixth and final tour was well attended, with Dr. Grego, several of my friends, and multiple groups of park visitors. After missing an alligator for the past five tours, we were finally able to see the alligator in Weston Lake this time. While this group was not quite as energetic as other tours I have had, I believe everyone was well engaged and interested, making this a satisfactory conclusion to the project.

Alligators:

Introduction

American Alligators are (with the exception of American Crocodiles) the largest reptile to be found in North America. It's range spans across the south-east United States, wherever there are warm temperatures and suitable bodies of water. The American Alligator can be found in the coastal plain regions of the Carolinas and Georgia, and in much of Alabama. It is found in almost the entirety of Florida, Mississippi, and Louisiana, as well as the Gulf Coast region of Texas. Some Alligators have been found as far north as Virginia. Only one other species of alligator, the Chinese Alligator, is known to exist. These two alligators are members of the family of crocodilians, which consists of alligators, crocodiles, and caimans (C. C. Lockwood, 2002). Twenty three species of crocodilians can be found across the world, appearing in the Americas, Africa, South-east Asia, and Australia (Ross & Garnett, 1989).

Based on fossil records, the earliest crocodilians emerged on the planet around 200 million years ago. Since then, little about their design has changed (Alderton, 1991). Alligators in their current form have existed for the past 6-8 million years, a testament to the effectiveness of their form and function (Whiting et. al., 2016). Few other species have existed for so long without undergoing significant evolutionary change. In many ways, crocodilians are more closely related to birds than to any other group of vertebrates (including other reptiles). Both birds and crocodilians are believed to be descended from dinosaurs, making crocodilians perhaps the closest thing we have to modern dinosaurs today (Ross and Garnett, 1989).

Most species of crocodilians are restricted to the tropical regions of the world, where average temperatures do not drop below 10-15℃ even during the coldest part of the year. Alligators, however, are an exception to this rule. While their preferred temperature ranges from

32-35℃, they have been known to remain active when temperatures are as low as 12-15℃. As a result, they inhabit temperate regions of the world inhospitable to other crocodilians (Ross & Garnett, 1989). While alligators can tolerate colder temperatures, they too have limits. In North America, the American Alligator is generally not found further north than the -9.4℃ isotherm (Alderton, 1991). As the climate changes, the exact boundary of this temperature limitation changes as well.

All crocodilians are largely aquatic animals, coming onto land primarily for basking. Most species of crocodilians are freshwater, with some inhabiting estuarine habitats or even venturing into the ocean (Ross & Garnett, 1989). Crocodiles have special salt glands which allow them to excrete the excess salt they take in when residing in saltwater habitats (Taplin & Grigg, 1981). Alligators, however, lack these specialized glands. While they are able to reside in saltwater for short periods of time, they are unable to tolerate these conditions for the same duration as other species of crocodilians (Ross & Garnett, 1989).

Across the 23 species of crocodilians, there is great variety in size. The smallest, Cuvier's Dwarf Caiman, reach a maximum length of only 5 feet for males and 4 feet for females. The largest, the Indo-Pacific Crocodile (or Saltwater Crocodile), has been said to exceed 30 feet in length, though this has not been reliably documented. The American Alligator occupies the middle region of this range. Males rarely grow past 13 feet, while females tend to peak around 9 feet. However, exceptions to these have been noted in the past (Alderton, 1991).

Physical Traits:

Crocodilians possess sharp, conical teeth-highly effective at stabbing into their prey. Unlike other reptiles, crocodilian teeth are thecodont, meaning they are set in sockets rather than fused to the top or side of the jaw (Mazzotti; Charles A. Ross & Stephen Garnett, 1989). Like

sharks, crocodilians shed their teeth throughout their life, initially developing new teeth in a separate region before transferring them beneath an existing tooth. This enables crocodilians to regrow teeth that may be lost as a result of biting into bone or other hard substances. Even if teeth are not lost due to biting, they will be shed naturally, alternating along the jaw to avoid hindering the animal's biting capabilities (Alderton, 1991). Unlike many crocodiles, alligators' teeth are not visible when their jaws are closed, as the teeth from the lower jaw fit into pits along the upper jaw (Ross & Garnett, 1989).

Alligators, like all crocodilians, are well adapted for an aquatic lifestyle. Their tail, which comprises around half of their total body length, provides powerful propulsion when swimming, sweeping side to side in an S shaped pattern. Generally, they hold their limbs in tight to remain hydrodynamic, though they will use their back feet (which are partially webbed) to assist with steering and balance. Most reptiles (those with legs) walk with their legs splayed out to the side. However, alligators (and other crocodilians) walk with their legs directly beneath their body, enabling them to remain elevated above the ground. If frightened, alligators can utilize a quick gallop, though their large size makes this difficult to sustain. When re-entering the water, alligators will slide on their belly, twisting side to side (Ross & Garnett, 1989).

When submerged, alligators are able to hold their breath for an extended period of time. Like many animals, alligators have a physiological reaction to submerging underwater-a dive reflex. Their heart rate slows, blood flow to certain parts of the body is reduced, and flow through muscles is reduced or cut off. As a result, alligators are able to hold their breath for an average of about 20 minutes, though some have been known to hold their breath for even greater periods (Andersen, 1961).

In addition to holding their breath, alligators have other adaptations to improve their functionality when underwater. They possess a third, transparent eyelid, known as a nictitating membrane, which covers their eyes underwater and would seem to better allow them to see. Flaps of tissue will also cover their ears, preventing water from entering when submerged. In addition, alligators can close off their throat when underwater, allowing them to open their mouths for hunting when underwater without taking in water. The position of their nostrils (on top of the snout) allows them to remain above water when the alligator is largely submerged, enabling the alligator to continue to breathe despite being almost entirely underwater (Alderton, 1991).

Like other reptiles, alligators are ectothermic, meaning they rely on outside sources of energy to regulate their body temperature. This is in contrast to endothermic animals, such as humans, which can regulate their body temperature internally. The primary source of heat for alligators is the sun, and their exposure to solar radiation is regulated by behavioral changes. To raise their body temperature, alligators will bask in the sun, often coming onto land. Submerging beneath the cool water allows them to lower their body temperature again. Generally, alligators will emerge to bask in the morning and re-submerge in the evening, though the exact timing of these behaviors varies depending on the season and daily conditions (Ross & Garnett, 1989).

An alligator's skin is lined with bony plates, called osteoderms, which cover its back and tail. These osteoderms interlock and serve as effective armor, protecting alligators from damage (though often the only animals that would hurt an alligator are other alligators). Historically, crocodilian skin has been used by humans as armor, and, under certain conditions, has been shown as bulletproof (Sun & Chen, 2013). In addition to serving as protection, there is some indication that alligator osteoderms assist with thermoregulation. Blood vessels flow through the

osteoderms, and the elevated ridges create additional surface area for solar radiation to hit and warm this blood (Owerkowicz, 2016) (Seidel, 1979). However, this proposed reasoning is not entirely supported and merits further investigation (Clarac et. al., 2017).

Countershading is a common coloration pattern found in many aquatic animals. It describes a pattern where the animal's underbelly is light in color while its back is notably darker. When viewed from above the water, the animal's dark back blends in with the water's surface. However, when viewed from below, the lighter underbelly blends in with the light coming from above the water. This pattern helps to enable more efficient camouflage, and is found in many fish, turtles, or penguins (Ruxton et. al., 2004). It is also found in alligators, who rely on camouflage for hunting.

Hunting:

Alligators are opportunistic feeders, taking advantage of any prey unfortunate enough to cross their path. Generally, they will hide near the shoreline, submerged almost entirely beneath the water. Their eyes, located on top of their head, can remain above water to look for prey. When something comes to the water's edge, alligators will lunge with surprising speed, snatching the animal in its powerful jaws. Alligators then pull their victims underwater, holding them down until they drown (Ross & Garnett, 1989).

The bite force of crocodilians has been measured as the greatest in the animal kingdom, enabling them to crush bone and shells of their prey. American Alligator bite force has been shown to reach 9452 N, a force unmatched among living animals except for other crocodilians. It has been estimated to exceed the bite force of a number of larger dinosaurs, though naturally this cannot be directly tested (Erickson et. al., 2003). However, surprisingly, the force alligators exert

when opening their jaws is significantly less, allowing their jaws to be held shut with relatively little effort (Alderton, 1991).

By utilizing an ambush strategy for hunting, alligators minimize the amount of energy spent acquiring food. Compared to mammals or other ectothermic animals, alligators' energy demands are further reduced as they do not expend energy regulating their body temperature. In addition to having low energy demands, alligators have developed highly effective means of retaining energy from their diet. Crocodilians have highly acidic stomachs, higher than any other group of vertebrates. This allows them to fully digest their kills, including the bones. Crocodilians also store most of the energy contained in their prey (approximately 60%) as fat, which they can draw on as energy reserves when needed. However, because they are well adapted to minimal energy usage, alligators are easily exhausted after periods of intense activity, and they are generally unable to sustain high energy demands for any extended period of time (Ross & Garnett, 1989).

Life Cycle:

In the spring, alligators respond to increased temperature with increased hormone production, and by the months of April and May they are ready to mate (Ross & Garnett, 1989). During this time, both male and female alligators will signal their readiness to mate through loud bellows and other means of noise production, such as head slaps (Alderton, 1991). Variations in bellows can provide an indication of body size, and may be interpreted by alligators to help judge potential mates (Reber et al., 2017). In regions with a sufficient population, large numbers of alligators will congregate for courtship gatherings. In these events, males will compete for dominance, sometimes fighting each other for the right to mate. Interested females will make contact with males, and they will engage in courtship behaviors such as: snout contact, chasing,

or laying chins atop one another. Couples which decide to mate will generally leave the group to do so. Often times they will wait until after the group has dispersed (Dinets, 2010).

In populations of alligators, dominant males generally control the mating process. They will mate with multiple females and work to prevent other males from mating. Despite their efforts, many female alligators have been found to successfully mate with other, subordinate males (in addition to mating with the dominant male). Thanks to advances in genetic technology, scientists have been able to examine the relatedness of sample clutches of eggs. In doing so, they determined that somes nests were sired by multiple males, providing evidence of multiple paternity as a reproduction mechanism for alligators (Davis et. al., 2001).

Once they have mated, male alligators leave their partners and have no involvement with their offspring. Females, however, will provide some measure of care for their eggs and juveniles. After mating, females will begin selecting nest sites on land to lay their eggs. When constructing nests, females will flatten the vegetation in her selected area, creating "trails" by following the same paths between the water and her nest site. Females will then construct the nest itself, collecting vegetation and piling it into a cone shaped structure with a cavity in the middle, where eggs are laid (Joanen, 1969). During this time, the female alligators will offer some degree of protection for the nest. When attending the nest, females will respond to apparent threats with a series of aggressive displays, ultimately attacking if the threat does not withdraw (Kushian & Kushian, 1980). However, females do not consistently remain by their nests. Recent examination of this behavior in Louisiana and Texas indicated that alligators attend their nests most frequently immediately after laying their eggs. Attendance declined after the first couple weeks, but it increased sharply again as the time for hatching approached. Additionally, the majority of nest visits occurred at night, though daytime visits were more frequent as the

incubation period came to an end. These trends may be a response to predation risk. Alligator eggs appear to be at increased risk of predation immediately after being laid, perhaps due to the increased scent, which decreases as the eggs dry. In addition, some of the primary predators of alligator eggs, like raccoons or wild hogs, tend to be nocturnal. While nest attendance is a characteristic behavior of alligators, it is also subject to regional variation, being more common in some regions compared to others. The reasons for this geographic variation are not well understood (Merchant et. al., 2018).

While sex is determined by chromosomes for humans, alligators (and many other reptiles) have a different mechanism. For them, sex is determined by temperature. During incubation, the ambient temperature of the egg influences its development as a male or female. Incubation temperatures above 33°C will produce male offspring, while incubation temperature below 30°C will produce females. If the average temperature is in between, it will result in a mix of males and females. A combination of males and females can also be produced by virtue of the fact that eggs at different depths within the nest may be exposed to different ambient temperatures (Alderton, 1991). The underlying mechanism of temperature based sex determination is still not well understood, though recent analysis has demonstrated the importance of the TRPV4 channel (Yatsu et. al., 2017).

On average, female alligators will lay 35-40 eggs, with some variation based on geographic region. Incubation lasts approximately 65 days. At the end of this period, the juveniles will begin to grunt and chirp within their eggs, signaling their mother that they are ready to hatch. In response to this signal, the mother will open the nest and remove the eggs, carrying them in her mouth. If needed, she will assist with hatching, using her tongue to gently

crack the egg open. Once the young alligator is hatched, she will deposit it in the water (Ross & Garnett, 1989).

Young alligators measure less than a foot after hatching, and they are vulnerable to any number of predators. Females will remain close to her hatchlings, attempting to ward off potential threats, though some will always be lost to predation (Alderton, 1991). Young alligators may grow approximately a foot per year for the first years of their life, assuming they have access to sufficient food. Once the juveniles have reached sufficient size, mothers will cease providing care for them. She may even chase them away, as they would compete with her for food (Ross & Garnett, 1989).

As alligators approach sexual maturity, their rate of growth begins to slow, with females tending to grow more slowly than males. Alligators reach sexual maturity once they have attained approximately 6 feet in length. Males may reach this point at 7-15 years of age, while females will reach it at 9-18 years of age. The exact time taken to reach maturity varies by geographic location, as populations further north (where temperatures are cooler) tend to take longer to reach maturity (Ross & Garnett, 1989) (Wilkinson and Rhodes, 1997). The difference between male and female growth rates upon reaching sexual maturity is likely due to the increased energy investment required by females for egg production and other reproductive behaviors (Wilkinson et. al., 2017).

Once they have left the family unit, alligators must begin to compete for territory and, if they are males, access to mates. Alligators tend to be territorial creatures, though they have been known to congregate for group feeding or to share basking areas. Young males may find themselves excluded from preferred territories by older, larger males (Lang; Charles A. Ross & Stephen Garnett, 1989). This competition may also prevent young males from mating when they

reach sexual maturity, forcing them to wait until they have reached greater size (often 8-9 feet) to successfully mate (Ross & Garnett, 1989).

Male alligators can reach lengths of up to 13 feet, while females can reach up to 9 feet (Alderton, 1991). It has been thought that alligators exhibited indeterminate growth-meaning they continue to grow their entire lives, albeit at greatly reduced rates upon reaching a certain age. However, more recent work suggests that alligators do in fact reach a point at which they cease growing in length, though they will continue to grow in width (Wilkinson et. al., 2017) (Wilkinson and Rhodes, 1997). Under good conditions, alligators have been known to reach upwards of 70 years of age (Wilkinson et. al., 2017).

Ecological Impact:

As apex predators, alligators play an important role in controlling prey populations. However, they play additional ecological roles that may be more surprising. One particularly significant contribution they make is the construction of alligator holes. Alligator holes are depressions in the muck or bedrock which are created or maintained by alligators (as they dig out mud and plant matter to empty the hole). While these holes help provide refuge for alligators, they are also utilized by other aquatic animals for shelter. In addition, other animals will come to the hole seeking water or opportunities for hunting. During dry periods, these holes are particularly important as they will continue to have water. In addition to benefiting animals, alligator holes can influence the surrounding pant community. By mixing the soil and removing some vegetation, alligators can enable a greater diversity of plants to grow around their hole, increase spatial heterogeneity (Palmer and Mazzotti, 2004) (Liu et. al., 2004).

An interesting relationship between wading birds (particularly egrets and herons) and alligators has also been the focus of some recent research. These birds nest colonially, forming

nest sites called rookeries along bodies of water. Examinations of rookery locations for these birds found that they almost exclusively chose to nest in locations with alligators present. In addition, the presence of a decoy alligator served to attract birds to potential nesting sites. The proposed explanation for this behavior is that alligators offer a measure of protection for nesting birds, as their presence would deter other predators, such as raccoons or opossums, that might come for the birds' eggs (Burtner and Frederick, 2017). This association also has benefits for the alligators. Alligators living in ponds with rookeries have demonstrated increased morphometric body condition indices (essentially, indicators of body size and health). The presence of rookeries has been tied to increases in local primary and secondary productivity, which would result in increased food availability for alligators. There is also a more direct association to be made: eggs and/or chicks from the nests will inevitably fall into the water, resulting in an easy meal for alligators (Nell et. al., 2016).

Alligators and Humans:

Historically, the primary predators of alligators (in the adult stage) would almost certainly be humans. Native Americans are known to have hunted alligators, particularly in Florida. European depictions of Native American alligator hunts show groups of people working together to drive a pole into the alligator's mouth, causing it to bite down on the pole. With it's dangerous bite removed from the equation, the hunters could then work to flip the alligator onto its back, exposing its less armored underbelly to arrows and other weapons. European colonists began utilizing alligator skin for boots and other products, though this trade was relatively quite small. However, in the late 19th Century, demand for alligator skin products skyrocketed, leading to massive increases in alligator hunting. By the 1950s, alligator populations were in sharp decline (as were crocodilian populations around the world). However, the the Endangered

Species Conservation Act in 1969, as well as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1973, made provisions for the conservation of alligators and other crocodilians, with regulations on their hunting and trade (Ross and Garnett, 1989). These efforts proved quite successful at enabling alligator populations to rebound, and in 1987 they were officially removed from the endangered species list. Their impressive recovery makes them one of the most notable successes of the endangered species program (*American Alligator: Alligator mississippiensis*, 2008).

While alligators have been known to seem to hunt humans, these instances are incredibly rare. Many would say that female nest defense or male territorial defense could be considered common causes for alligator attacks. However, it should be noted that defensive females or males will almost always make their presence known and provide ample warning before choosing to attack. Most alligators prefer to avoid contact with humans, generally retreating whenever humans come too close (Ross and Garnett, 1989). Provided we maintain a respectful distance and exercise caution around bodies of water where alligators are known to live, it is quite simple to coexist with alligators.

In South Carolina, it is illegal to feed alligators, punishable by a $200 fine from the DNR. This is because alligators which are fed by humans become more accustomed to human presence, often beginning to approach humans for more food. In time they can become more aggressive towards humans in search of food. In these cases, the alligator at a minimum need to be relocated, if not put down for people's safety. While working at Fripp Island, I was part of a group that went to investigate reports of fed alligators, and it was decided that some of the alligators in question needed to be removed. While I was not present for this, other naturalists investigated a different alligator later in the summer. In this case, it was determined that the

alligator could be left alive but needed to be relocated. In many cases, the alligator is not so lucky, hence the saying “A fed gator is a dead gator.”

Raccoons:

Introduction:

Raccoons are members of a unique group of mammals known as the procyonids. All procyonids are small to mid-size mammalian carnivores which prefer to dwell in trees. Characteristic traits of this family include an omnivorous diet and a nocturnal lifestyle. In addition to raccoons, the procyonids include animals such as kinkajous, ringtails, and coatis (Zeveloff, 2002).

There are potentially seven species of raccoon, although only one species, the common raccoon, is widespread. Most of the other species are only found on individual islands, and scientists debate whether or not they should truly be considered separate species from the common raccoon. The most distinct species, the crab eating raccoon, is found in Central and South America. This paper discusses the common raccoon, which is widespread across North America (Zeveloff, 2002). It is believed that raccoons originally evolved in the South-West United States, though they have moved north over the centuries. Their northern limit remains unclear, though they have been found in the northern regions of Canada (Latham, 2008).

Raccoons are similar in size to a large house cat. They can range from 2-3 feet in length and weigh 20-30 pounds. Males tend to be moderately larger than females, on the order of 10-15% heavier and several inches longer. Raccoon fur is gray to black in color, with some variation based on geographic region (their fur tends to be lighter in warmer climates). Their signature features include the black “bandit mask” around the eyes and their ringed tail. The exact function of the mask remains unclear, although there are several hypotheses. For example, the mask may help raccoons to distinguish themselves from one another, serving as individual markings. The mask could also function as a target when raccoons are fighting, as this region is heavily furred

and may offer better protection. It could help enhance facial expressions or help make the raccoon appear more intimidating. It could even help with vision, augmenting night vision and/or reducing glare during the day (Zeveloff, 2002).

Raccoons evolved as arboreal animals, and they are well adapted for a lifestyle of climbing. They possess claws which enable them to dig into and climb trees, or other surfaces such as buildings. They are able to rotate their back feet 180 degrees, enabling them to climb down trees head-first. Raccoons are also surprisingly resilient when it comes to falling and have frequently been observed falling from great heights and sustaining no injury. (Zeveloff, 2002).

Today, raccoons have spread beyond the forest and occupied virtually every habitat that can be found across the United States and Canada. A significant reason they are able to adapt to new environments so well is their omnivorous diet. While raccoons are part of the order Carnivora, they can and will eat any number of food items, from wild fruits and seeds to the leftovers we throw out in the garbage. Raccoons can eat just about anything humans can eat, and this ability to readily exploit the food we throw away has helped raccoons to thrive in urban environments (Fleming, 2012).

The Meaning of the Name:

The full scientific name, *Procyon lotor*, was assigned in the late 18th century. In his initial classification of raccoons, Carolus Linnaeus (who developed the system of binomial nomenclature we still use for scientific names today), placed raccoons in the genus *Ursus*, as he considered them to be related to bears. One of his students, Gottlieb Conrad Christian Storr, later assigned raccoons to a new genus, *Procyon*. Procyon comes from Latin for “before the dog,” and would suggest that Storr was attempting to recognize the raccoon’s dog-like traits. While this was an improvement from classifying raccoons in the same family as bears, the name Procyon is

not entirely accurate, as raccoons are not ancestors of dogs, nor are they significantly close to the canine family (Zeveloff, 2002).

The species name, *lotor*, is Latin for "the washer." This name refers to a raccoon's apparent tendency to wash its food in water (Zeveloff, 2002). Raccoons are frequently known to dunk their food in water when eating, but we have learned that they are not actually washing it. In fact, they are wetting their hands to increase their sense of touch. Raccoons possess extraordinary tactile abilities, with approximately four times the number of receptors in their paws as we have in our hands. When they moisten their paws, they soften calluses and innervate nerve bundles, increasing the sensitivity of their sense of touch even further. Their touch can function almost like taste, allowing them to easily identify objects (including potential food) without needing to see it (Fleming, 2012). While researchers in the early 1900s recognized the importance of touch for raccoons (Whitney, 1933), it took some time for us to fully understand the reason why raccoons appeared to wash their food. Until relatively recently, it was commonly believed that raccoons lacked proper salivary glands, and that moistening their food enabled them to better digest it (Zeveloff, 2002).

Even when water is not present, raccoons will rub their paws together, functionally increasing the sensitivity of their nerve endings as they would with water. When they are holding objects, they will also roll them between their paws, feeling and exploring the entire surface. With their long, dexterous fingers, their impressive sense of touch is aided by their exceptional dexterity, which enables them to easily manipulate and explore small objects. This tendency to rub their hands, as well as any objects they hold, is actually responsible for the name raccoon. Native Americans across the continent had many different names for raccoons, but European settlers adopted the name given by the Algonquin Tribe (the tribe of Powhatan and his daughter

Pocahontas). The name they gave raccoons was pronounced “Ah-rah-koon-em,” which translates approximately to “one who rubs, scrubs, and scratches with its hands” (Holmgren, 1990).

The ability to identify objects without relying on sight is a useful adaptation for raccoons, who frequently forage for food by digging through dirt, mud, or trash piles. This enables them to keep watch for potential danger while digging and searching for food. Their dexterous hands are well suited for climbing, enabling them to grip tree branches and other surfaces. In addition, their ability to skillfully hold and manipulate objects aids them in solving puzzles and challenges they encounter. While raccoon intelligence will be discussed in greater depth later, it is commonly suggested that an animal’s intelligence correlates well with its ability to manipulate objects. Raccoons are exceptionally good at manipulating things with their hands, and they are exceptionally intelligent, supporting this proposed correlation (Fleming, 2012).

Life Cycle and Social Interaction:

Mating season for raccoons, as for many other animals, occurs during the spring. Male raccoons will engage in consortship behavior with females, often sharing a den site for several days before potentially mating (mating does not always occur following a consortship period). Males will compete for access to females, often attempting to sequester their chosen female away from other males. Dominant males tend to mate with multiple females, while subordinate males are excluded. Females may also mate with multiple males, including subordinate one with whom they are not consorting (Gehrt & Fritzell, 1999). In these instances, females may have litters which were fathered by different males, indicating multiple paternity (Nielsen & Nielsen, 2007).

Gestation for raccoons lasts approximately 60 days, and females will give birth to litters of around 2-5 kits. While the fathers are typically absent, mothers will care for and raise their

young. A newborn raccoon's eyes and ears are shut, and they do not open for the first several days after birth. The young raccoons remain in the den for around 8-10 weeks, nursing on their mother's milk (Zeveloff, 2002). Even after they are ready to eat solid food and leave the den site, mothers keep a close watch on their young, protecting them from danger and teaching them all she knows about obtaining food-especially from human sources (Fleming, 2012).

Some raccoons will be ready to begin life on their own as early as the fall after they are born, others will wait until winter. By the following spring, raccoons will have separated on from their mothers. Siblings may continue to live in association with one another, denning together during their first winter, though the duration of this relationship varies. Familial associations seem to decline during reproductive season, and raccoons that are not sexually active are more likely to remain associated with family members (Zeveloff, 2002).

In the past, it has been commonly assumed that raccoons were largely solitary animals. However, recent research indicates that raccoons will live communally more often than previously expected. Studies have found that urban populations, with a high population density in a relatively small area, can be significantly more interconnected than previously expected, with almost all members of the population interacting with one another to some degree (Hirsch et. al., 2013). Social groupings between young males tend to be the most common form of raccoon interaction (after mother-child groupings), while male-female and female-female associations are less common (Prange et. al., 2012). Male raccoons will join together in groups to defend their territories and access to females. The formation of these groups does not appear to be influenced by relatedness, as they appear to be equally likely to form between related and non-related raccoons. However, related raccoons may be more likely to remain together for a longer period of time (Gehrt et. al. 2008). In addition to defending territory and mating access,

these social networks may communicate about food resources, alerting one another when new food sources are made available (Fleming, 2012).

Intelligence:

Raccoons have long been recognized as exceptionally clever animals by Native Americans, and multiple cultures across North America featured them as tricksters in their stories (Holmgren, 1990). In the early 1900s, scientists began examining animal problem solving and intelligence, and raccoons were some of their early subjects. These experiments tested problem solving ability by challenging the animals to open a variety of fastenings, discrimination of size and color, and ability to learn from repeated actions. This early research indicated that raccoons were more intelligent than cats, but not quite as intelligent as primates (Cole, 1907) (Davis, 1907). Early behaviorists noted the raccoons' exceptional curiosity and inquisitiveness, a trait shared by few other animals. In many ways, they argued that raccoons solved problems and behaved in ways thought to be unique to humans and primates, perhaps even possession the capability to have ideas, though these suggestions were controversial (Pettit, 2010).

In the following years, raccoons never attained the same popularity as test subjects as other animals, due perhaps in part to their rebellious and unmanageable nature (Davis, 1984). However, more recent experiments have shed new light on the intelligence of these animals. One recent project focused on comparing the intelligence of cats and dogs on the basis of brain structure and neuron count, and raccoons were examined as an additional element. To the researchers' surprise, raccoon neuron count exceeded both cats and dogs, approaching levels comparable to primates (Jardim-Messeder et al., 2017). Another common problem solving test, the "Aesop's Fable paradigm" was recently used with raccoons. In one of Aesop's fables, an intelligent crow drops rocks in a pitcher filled with water to raise the water level and retrieve the

food within. A variety of animals, from primates to crows, have been tested with this experimental concept to determine if they possess the problem solving ability described in the fable. When it was tested with raccoons, two out of the eight animals were able to successfully complete it via the expected mechanism of dropping objects into the water. A third raccoon almost retrieved the treat via the normal method but was reluctant to fully reach down and retrieve the food. Instead, she found a way to destabilize the experimental apparatus and knock it over, causing the water to flow out and enabling her to eat the treat inside. The researchers noted that the experimental design, while well suited for other animals, could be modified to better suit raccoons' particular traits. For example, some of the raccoons were reluctant to let go of the stones intended to raise the water level, preferring to hold on to and play with the stones instead. Even so, the authors noted the intelligence displayed by the raccoons and noted their desire to conduct further research (which is currently ongoing) (Stanton et. al., 2017).

Invasive Raccoons:

While raccoons are only native to North America, they have been introduced to both Europe and Asia, where they have had great success but have also become a problematic, invasive species. In Germany, we are aware of 2 primary introduction events: a release of 2 males and 2 females in 1934 and the escape of 25 raccoons from a fur farm in Wolfshagen. However, genetic analysis suggests that there have been at least 4 introductions into Germany (Fischer et al., 2015). Similar analysis revealed at least 2 instances of introduction in Spain, though we do not have notable historical records of these events (Alda et al., 2013). Most introductions across Europe are believed to have consisted of only a few individuals, resulting in relatively low genetic diversity among European raccoon populations. These introductions may

have occurred as a result of fur farms in the 20th Century, though the recent pet trade in raccoons has also resulted in more animals becoming loose in Europe (Salgado, 2018).

The pet trade was responsible for the introduction of raccoons in Asia, particularly Japan. In 1977, Japan produced an animated series, Rascal the Raccoon, based on the American book and subsequent movie about a boy and his raccoon pet (who, ultimately, needed to be returned to the wild). The popularity of this cartoon inspired significant demand for pet raccoons in Japan, as they did not yet understand the challenges of living with a raccoon. Many of these pet raccoons were released upon becoming too big, leading to Japan's invasive raccoon population. Unfortunately, Japan's raccoons have been the source of significant problems, such as the inadvertent destruction of ancient temples. Japan has attempted to implement management practices, even adopting a no tolerance policy for some temples. However, like Europe, they have found raccoon populations to be notoriously difficult to control (Flemming, 2012).

Raccoons and Humans:

While many animals react poorly to increased human presence, raccoons have been known to thrive in urban environments (though even in urban areas, they prefer to dwell in green spaces such as parks). Part of the reason for this is a raccoon's omnivorous diet. Raccoons are able to eat almost anything humans find edible, and they readily exploit the food we throw away. In addition, raccoons are highly flexible when selecting den sites, and they are easily able to utilize manmade structures as substitutes for "natural" dens (Gross et. al., 2012). Due in part to the high concentration of resources, raccoon territories tend to be smaller in urban areas than in non-urban regions, potentially enabling more raccoons to occupy a smaller overall space (Prange et. al., 2004).

In addition, raccoons' mental attributes are well suited to surviving or thriving in human environments. Traits such as neophilia (an attraction to novel things or places) and boldness serve raccoons well in confronting the challenges of human presence, and their intelligence and problem solving capabilities enable them to solve these challenges (Barrett et. al., 2019). This has been particularly evident in Toronto, known as the "raccoon capital of the world." In 2016, Toronto implemented new, "raccoon-proof" trash bins, the product of a $31 million dollar effort to keep raccoons out and trash in. But in 2018, footage of raccoons successfully opening these bins emerged, much to the city's chagrin. This is one of the more notable of a larger phenomenon. Urban raccoons tend to be better problem solvers than their non-urban counterparts, likely as a result of the experience gained from solving human efforts to keep them out. In short, our efforts to hinder raccoons are making them smarter (Dempsey, 2018).

While life in urban environments offers many advantages for raccoons, there are negative factors as well. Human food is an abundant and effective food source for raccoons, but it comes with the same dietary concerns as it does for people. Recent comparisons of urban and non-urban raccoons have found that urban raccoons tend to be notably heavier and exhibited higher blood glucose levels (Schulte-Hostedde et. al., 2018). Urban raccoons also exhibit signs of increased tooth decay and greater lethargy, factors consistent with a diet of increased fats and sugars. In addition, raccoons in cities face potential danger from increased contact with humans. Collisions with cars are one of the greatest sources of mortality among raccoons, and lethal trapping is another significant concern (Fleming, 2012).

Wildlife Rehabilitation

Due to their widespread range and frequent interaction with humans, raccoons are common patients at wildlife rehabilitation centers. Unfortunately, they are often admitted due to

human actions. However, recent research has lent support to the notion that they raccoon rehabilitation is a successful process (McWilliams and Williamson, 2015). The exact process for raccoon, or any wildlife, rehabilitation will vary from state to state, depending on local regulations and practices. This following section describes my own experiences with wildlife rehabilitation in Illinois.

During my summer at the wildlife rehabilitation center, we received numerous calls from people who had found raccoons that appeared to be in trouble, far more than we could adequately care for. The first step when we received these calls was to ascertain whether or not the raccoon actually needed assistance. It could be possible (and was often the case) that a juvenile raccoon had been separated from his mother and that the mother would be looking to come back for him. If the raccoon was a juvenile who was not noticeably sick or injured (and there was no evidence of a dead mother), we would talk people through setting up at attempted reunite. To set up a reunite, you return the juvenile raccoon where you found him, secured in such a way that he cannot get out but the mother can get in to retrieve him. For example, you could leave the juvenile in a pet carrier with the door unlatched but propped shut with sticks on the outside. The baby will not be strong enough to open the door and wander off, but the mother raccoon can easily knock the sticks away, open the door, and retrieve her baby.

We would have people set up attempted reunites at night, when the mother would be most active and most likely to come looking for the baby. If the raccoon was still there the following morning, we would have the people bring him to the center. When accepting new animals, we would first do a health inspection to see if there were any immediate concerns that needed to be addressed (signs of sickness or other conditions that could be treated). All new animals would be kept in a separate enclosure, away from the others, for the first few days. This

helped give the new arrivals time to adjust to their new surroundings and gave us time to see if they had any diseases that could spread to others. Assuming there were no abnormal conditions, we would soon more the new animal into a bigger enclosure with others.

Many of the raccoons we received as patients were quite young and would still be nursing if they were with their mother. Therefore, it was up to us to bottle feed them. We used specially designed raccoon formula-a powder mixed with hot water that closely resembled natural raccoon milk. When feeding them, we had to ensure the formula was warm-but not so hot that it would hurt them. Interestingly, some raccoons seemed to have temperature preferences, feeding better when the formula was slightly warmer or cooler than the normal temperature we would use. The youngest raccoons would be fed via syringe, meaning we would slowly release formula into their mouths for them to swallow. The rest could feed from baby bottles. We would feed the raccoons approximately four times per day, with decreasing frequency as they transitioned to solid food. Their reliance on touch is readily apparent when bottle feeding them, as they tended to want to hold the bottle while or before feeding. In addition, while they were out they would try to feel everything around them, from kneading into your shirt to feeling your face.

Raccoons tend to stop nursing around 8-10 weeks old in the wild, and around this point we would transition them to eating solid food as well. We tended to feed our raccoons a variety of produce (whatever we could get donated) and puppy chow, though we would feed them other meats, yogurt, or other snack items when available. During the transition period to solid food, we would mix warm formula with some puppy chow for them to eat, thus softening the puppy chow and encouraging them to eat it. Of course, we gave them bowls of water as well. They enjoyed playing in their water bowls, dropping food in and getting their paws wet (enhancing their sense

of touch, as described earlier in the paper). As a result, it was quite common for them to spill their water bowls, often immediately after we refilled it.

Once the raccoons were eating solid food easily and had grown sufficiently big, we moved them from enclosures inside the nursery to larger outdoor enclosures. To make the transition, we would sometimes take the raccoons outside during the day and bring them back in at night, for a few days before moving them outside permanently. Once they were moved outside, we would interact with them less frequently, a necessary step for preparing them to be released into the wild.

Because raccoons are such intelligent and curious animals, they need something to keep their minds stimulated. Our situation was not ideal for providing space and enrichment for our raccoons, but we did the best we could with the resources available. When raccoons were in the nursery, we allowed them to climb out and explore while we were cleaning their enclosures (which was sometimes necessary multiple times a day). We also provided hammocks, stuffed animals, and various toys. Sometimes, something as simple as adding some sticks or branches into their enclosure could provide enrichment, giving them something new to feel or climb on. The outdoor enclosures had more space for the raccoons to keep active. Additions of large branches, tire swings, or other structures gave them additional space to climb. Each enclosure also had a small pool and a nest box, both of which received frequent use.

My time at Second Nature was not long enough to be able to release any of the raccoons we took into care. I returned to school in August, and releases do not happen until the raccoons (who are born in the spring or early summer) are older-usually around late fall or sometimes not until after winter. A good release site has access to food, water, and shelter, and it is away from

busy roads and other sources of human danger. We could release raccoons on the Center's property, but other release sites had to be negotiated with property owners.

Unfortunately, not all raccoons who came to us ended up being releasable. Some were simply too sick or injured to ever be returned to the wild. In those cases, they stayed at the center as educational animals. At times, we would be invited to present to different groups about respect for wildlife and wildlife rehabilitation, and we would be able to bring some of our educational animals along for the presentation. While the circumstances that resulted in animals being unable to return to the wild are always unfortunate, I think their presence makes these kinds of presentations more impactful, hopefully inspiring attendees to show greater respect for animals in the future.

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Appendix 1:

Before beginning to hold my tours, I developed an outline for what I would discuss during the program. I drew on that outline (which has received some modifications since its creation) when developing the written component of my thesis. While I did not always cover every point on the outline or stick to the order written, I found it helpful to have a means of organizing my plan before presenting.

Alligators:

Section 1: What is an alligator?

Basic Characteristics

- 2 species of alligators in the crocodilians: Chinese and American
    - Crocodilians=largest reptiles in the world
        - Scales, cold-blooded, lay eggs
    - Aquatic, carnivores, powerful jaws and tails (used for swimming)
    - Descended from dinosaurs
    - Existed for millions of years
- Alligators are different from crocodiles/caimans because
    - Freshwater
    - Jaw structure
    - Sensory pits (gotta check)
    - Size

Habitat:

- American Alligator range across SE United States
    - Temperature range
- Live in bodies of water
- Vegetation cover for camouflage
- Could mention territoriality-probably more detail later

Special features:

- Camouflage
    - Countershading
    - Juvenile patterning
- Osteoderms
    - Bony skin: blood vessels
    - Surface area for absorbing/releasing heat
    - Relationship to dinosaurs (like stegosaurus)
- Teeth
    - Number of teeth
    - Shedding cycle and replacements
- Nictitating membrane
    - Third eyelid used when swimming

Section 2: Hunting

Ambush predators:

- Wait for prey
- Lunge at great speed to grab it
- Bite with powerful jaws
- Kill by drowning (death roll)

Bite force:

- Greatest in animal kingdom (crocodilians, at least)
- Specific alligator stats

Prey:

- Basically anything

Don't Need to feed often b/c low metabolism

Section 3: Life Cycle

Mating:

- Mate in spring
- Methods for attracting mates
    - Bellowing

Nesting:

- Number of eggs/when laid
- Make "nests" on land
- Incubation time

Temperature based sex determination

- Mechanism
- Differing temperatures in nest

Parental care:

- Mother cares for eggs/young, unlike many reptiles
    - Dad not involved
- Babies chirp when ready to hatch, mom helps

- Cares for them for the first few years
- Chases them off when they get too big

Growth:
- Grow based on how much they eat,
- About 1foot/year for first few years

Bachelor time:
- Around 3-4 feet, have to leave
- Find their own territory-compete
- Grow a bit more slowly now
- When they reach 5-6 feet (8-15 years), reach sexual maturity

Lifespan:
- 30-50 years
- Reach max length, then start growing in width

Section 3: Ecological importance

Apex predator:
- Control on prey

Relationship with nesting birds
- Mutualistic

Ecosystem engineers
- Gator holes can be used by other animals

Section 4: Alligators and Humans

Early hunting
- Native Americans (ex Florida)
- Colonial hunting
- Became hunted for gator skin products

Endangered:
- Protected with endangered species act in 1960s?
- Recovered very well
- No longer listed as endangered, except in Florida (crocodile)

Current problems with humans
- Feeding
    - Learn to associate people with food, become more aggressive
    - Often have to be put down
    - Fines from DNR for feeding

Raccoons:

Section 1: What is a raccoon?

Basic Characteristics:
- North American Mammal
    - Unique group (taxonomy)
    - 7 species, only 1 common
- Size
- Recognizable mask and striped tail
    - Quick description of reasons for these characteristics?
- Mostly nocturnal
- Range: across North America
    - Some have been introduced to other parts of the world (more detail later)
    - Forests, but adapt to anywhere (again, more later)
    - Common in cities now

Diet:
- Omnivorous: can and will eat just about anything
- Part of the reason they can adapt to almost any environment is because they can eat such a wide variety of things
- Do well in urban environments because they can eat our food

Hands/touch:
- Name comes from appearing to "wash" food
    - Lotor
    - Native American names
- Not actually washing, enhancing sense of touch
    - Water helps to activate nerves
    - Or just rubbing if there's no water
    - Touch is a very important sense
        - Could mention early observations about how they feel things without looking (cognition experiments)

        - Useful when digging up food-don't have to see it/be looking at it
    - Great dexterity, able to manipulate objects

Section 2: Life Cycle

- Mating season in spring
- Litters of 2-5 kits
- Mother raises offspring
    - In den for 8-10 weeks (nursing)
    - Multiple den sites
    - Mother comes out during the day more frequently to get food
    - Live with mother for up to 1 year
- Can maybe discuss things like range, number of den sites
- Ready to mate after 1st year
- Live 2-3 years in the wild, much longer in captivity

Section 3: Intelligence

Measuring animal intelligence

- Brief description of kids of tests
- Mention other notable animals

Native Americans recognized their cleverness

- Tricksters
- Names

Early 1900s, experiments

- Fastenings one
- Smarter than cats, similar to monkeys

Not frequently used as test subjects

- Not always cooperative

Neuron count

- Experiment was actually looking at dogs/cats, included some raccoons too
- Found raccoons had high neurons, similar to primates

Counting

- Could recognize the number 3

Aesop's fable test

- Used with other animals
- 2 of the 8 got it, 1 close
- Could be adapted for raccoon physiology better

Section 4: Raccoons and Humans

Hunted for pelts

- Native Americans
- Colonists

Problem in Cities

- Thrive in urban environments
- Notorious for getting in to garbage, homes
    - Diet allows them to eat food we throw away
    - Intelligence allows them to open sealed containers, work around efforts to keep them out
- Example of Toronto
    - Ongoing effort to design a raccoon-proof trash bin
- Taken to other parts of the world
    - Europe by colonists
    - Japan because of tv show
    - Causing problems there-invasive species

Wildlife rehab

- Common, successful

Appendix 2

This section features photos which were taken during my tours, including some notes to highlight points of significance. I received approval for the use of these photos in my thesis publication.

Tour 1

My first tour had some participants who left early on, as they did not realize the degree of walking involved with the tour. Nevertheless, we had a good group, and I was able to recognize several areas of potential improvement for subsequent tours.

Tour 2:




Modifications like a stop and talk style and the inclusion of the iPad helped with my second tour. We were fortunate enough to see some interesting animals, like a green anole or golden orb weaver.

Tour 3:




In addition to being my largest group, Tour 3 was special because the park was partially flooded. While this meant we could not utilize the lower boardwalk, we were also better able to spot a number of interesting animals.

All photos from the above three tours were taken by Ian Klauck.

Tour 4:

My first tour of the spring was well attended by an active group of participants (as well as my dad, who took these photos). We were able to spot more snakes this tour than any other time before, aided in part perhaps by the recent rains.

Tour 5:

Unfortunately, tour 5 was outcompeted by the Park's other Earth Day events. However, I would be remiss if I didn't include the picture taken by my mom, who did come down for the tour.

Tour 6:




While the alligator was difficult to photograph due to the distance and glare, we were able to see it in Weston Lake before even reaching the overlook area.

One of the two kids on the tour was also named Paul. He did a very good job at catching a blue tailed skink (and not injuring it), but he was understandably upset when it bit him. Despite that experience, he seemed to enjoy the rest of the tour.

Appendix 3

After my first tour, I prepared a slideshow that could be displayed on a tablet and referred to during my tours. This appendix includes the images used for this slideshow, as well as a brief description of how they fit into my overall program. Most of the images used were taken during my internships at Second Nature or Fripp Island. The remaining few were from public use sources online.

This map depicts the general habitat range of the American Alligator. I used it when introducing alligators to discuss where they could be found.

This photo was taken at Fripp Island. I used it when describing an alligator's preferred habitat: aquatic with vegetation for cover

I referred to this photo when describing how alligators would come onto land to bask

This is Archie, one of the educational alligators I worked with at Fripp Island. Thee photos were used to demonstrate alligator countershading

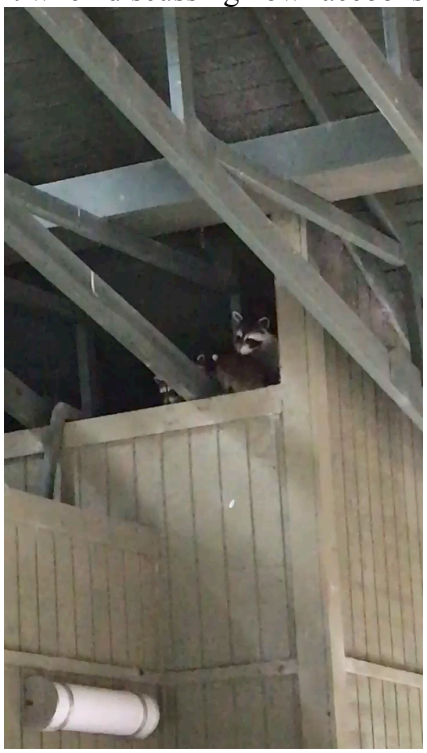
These photos of juvenile alligators helped demonstrate the juvenile camouflage pattern, as well as the small size of young alligators

I often used this photo as an opportunity to engage the kids on the tour, challenging them to find the alligator camouflaged behind me in the water. It also helped to demonstrate how well alligators can hide.

Archie lived with several turtles at Fripp, and while they would frequently rest on top of him, he would also rest on them. These pictures didn't particularly connect to anything in the tour, but people enjoyed being able to see them.

This map approximates the range of raccoons, though I discussed how they have been found moving further north

I took this photo of one of our raccoons who was released at the beginning of my summer at Second Nature. I used it when discussing how raccoons were arboreal animals

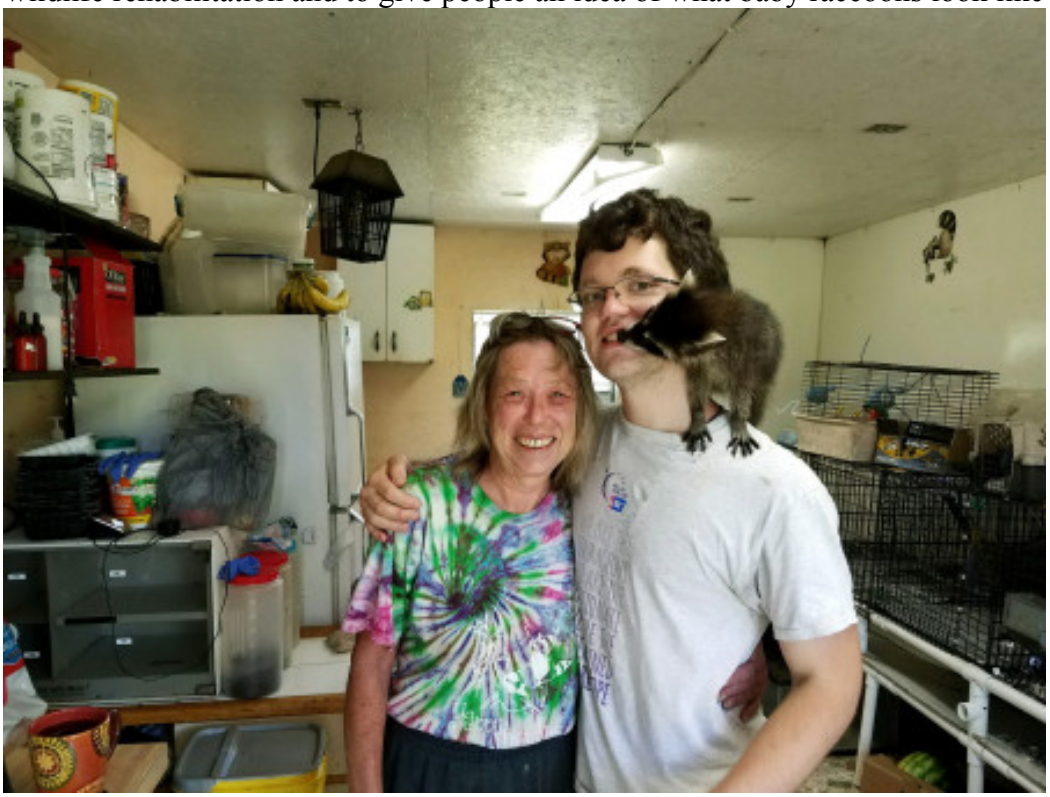


At Fripp Island, I observed a mother raccoon denning with her kits. I had intended to share this as a video, but I found that the videos did not load well when out at Congaree. It still served its purpose as an illustration of a mother and her kits

These photos illustrate the Aesop's Fable experiment, discussed during the intelligence section of my thesis and referred to during my tours.

The first photo here was taken by me at Second Nature. I included it to show how raccoons are capable of gripping objects (plus, I thought it was a good picture). The second picture was found online, and I included it as a reference to how raccoons are notorious for getting into trash cans (something they are able to do in part because of their dexterity)

These photos were both taken by me at Second Nature. I used them to begin my discussion of wildlife rehabilitation and to give people an idea of what baby raccoons look like



This photo was taken on my last day at Second Nature, and I referred to it when describing my time there

These photos of baby raccoons bottle feeding illustrated my description of how we fed young raccoons

This was used to accompany the description of bottle feeding raccoons. It helped illustrate their insistence when feeding (the bottle was empty at this time, but they were trying to feed anyway), as well as their dexterity in effectively grabbing and manipulating the bottle

Once raccoons were old enough, we could move them outside, and these photos helped illustrate some of the features of an outdoor enclosure (like the tire swing or the pool)

This picture has 7 raccoons in it (as well as a groundhog in the neighboring enclosure). I used it as another opportunity to engage the kids directly by seeing if they could find all seven raccoons

This is another picture which was intended to be a video but I found did not load well while on tours. It depicts George, one of our non-releasable raccoons who enjoyed spending time in the shower. It helped me discuss how some raccoons could not be returned to the wild.